



YDEEVNEDEKLARATION

DoP 0372

til Upat karmfastgørelse URD (Nylondübel til anvendelse i beton og murværk)

DA

1. Varetypens unikke identifikationskode:

DoP 0372
2. Anvendelsesformål:

Nylondybel til anvendelse i beton og murværk ved ikke-strukturelle applikationer (base materiale gruppe a b, c, d), se appendiks, specifikt Bilage B1 - B6.
3. Fabrikant:

Upat Vertriebs GmbH, Bebelstraße 11, 79108 Freiburg im Breisgau, Tyskland
4. Bemyndiget repræsentant:

-
5. System(er) til vurdering og kontrol af konstansen af ydeevnen:

2+
6. Europæisk vurderingsdokument:

EAD 330284-00-0604, Edition 12/2020

Europæisk Teknisk Vurdering

ETA-17/0811; 2025-01-16

Teknisk vurderingsorgan:

DIBt- Deutsches Institut für Bautechnik

Notificeret organ(er)

2873 TU Darmstadt
7. Deklareret ydeevne(r):

Mekanisk modstand og stabilitet (BWR 4)

Modstandsdygtighed overfor stålsvigt under træklast: Bilag C1

Modstandsdygtighed overfor polymerfejl og stålsvigt under tværlast: Bilag C1

Modstandsevne overfor udtræks- eller betonsvigt eller polymerfejl under træklast (base materiale gruppe a): Bilag C1

Modstandsdygtighed overfor enhver lastbærende retning uden trækstang (base materiale gruppe b, c, d): se appendiks, specifikt Bilage C3

Kantafstand og indbyrdes afstand (base materiale gruppe a): Bilag B4

Kantafstand og indbyrdes afstand (base materiale gruppe b, c, d): Bilag B5

Forskydninger under kortvarig og langvarig belastning: Bilag C2

Holdbarhed: Bilag A3, B1, B2

Brandbeskyttelse (BWR 2)

Brandegenskaber:Klasse A1

Brandbeskyttelse: Bilag C2
8. Relevant teknisk dokumentation og/eller specifik teknisk dokumentation:

-

Ydeevnen for den vare, der er anført ovenfor, er i overensstemmelse med den deklarerede ydeevne. Denne ydeevnedeklaration er udarbejdet i overensstemmelse med forordning (EU) nr. 305/2011 på eneansvar af den fabrikant, der er anført ovenfor.

Underskrevet for fabrikanten og på dennes vegne af:

Dr. Ronald Mihala, Chef for udvikling og produktionsledelse
Tumlingen, 2025-03-05

Dieter Pfaff, Leder af International Produktionsforbund og Kvalitetsstyring

Denne DoP er tilgængelig i forskellige sprogversioner. I tilfælde af fortolkningsmæssig uoverensstemmelse, henvises der til den engelske version, som altid er gældende.

Appendikset indeholder frivillige og udvidede informationer på engelsk. Disse overgår de lokale (sprogneutrale) retslige krav.

Translation guidance Essential Characteristics and Performance Parameters for Annexes
Oversættelsesvejledning Væsentlige kendetegn og præstationsparametre til anneks

Safety in case of fire (BWR 2)		
Brandbeskyttelse (BWR 2)		
1	Reaction to fire: Brandegenskaber:	-
2	Resistance to fire: Brandbeskyttelse:	$N_{Rk,s,fi}$; $N_{Rk,p,fi}$; $F_{Rk,fi,90}$ [kN]
Mechanical resistance and stability (BWR 4)		
Mekanisk modstand og stabilitet (BWR 4)		
3	Resistance to steel failure under tension loading: Modstandsdugtighed overfor stålsvigt under træklast:	$N_{Rk,s}$ [kN]
4	Resistance to steel or polymer failure under shear loading: Modstandsdugtighed overfor polymerfejl og stålsvigt under tværlast:	$V_{Rk,s}$ [kN]; $M_{Rk,s}$ [Nm]; $V_{Rk,pol}$ [kN]
5	Resistance to pull-out or concrete failure or polymer failure under tension loading (base material group a) Modstandsevne overfor udtræks- eller betonsvigt eller polymerfejl under træklast (base materiale gruppe a):	$N_{Rk,p}$ [kN] / $N_{Rk,pol}$ [kN]
6	Resistance in any load direction without lever arm (base material group b,c,d): Modstandsdugtighed overfor enhver lastbærende retning uden trækstang (base materiale gruppe b, c, d):	F_{Rk} [kN]
7	Edge distance and spacing (base material group a) Kantafstand og indbyrdes afstand (base materiale gruppe a):	c_{cr} ; s_{cr} ; c_{min} ; s_{min} ; a ; h_{min} [mm]
8	Edge distance and spacing (base material group b,c,d): Kantafstand og indbyrdes afstand (base materiale gruppe b, c, d):	c_{min} ; s_{min} ; h_{min} [mm]
9	Displacements under short-term and long-term loading: Forskydninger under kortvarig og langvarig belastning:	δ_0 ; δ_∞ [mm]
Aspects of durability		
Holdbarhed:		
10	Durability: Holdbarhed:	-

Specific Part

1 Technical description of the product

The frame fixing in the range URD 8 and URD 10 is a plastic anchor consisting of a plastic sleeve made of polyamide and an accompanying specific screw of galvanised steel, of galvanised steel with an additional organic layer or of stainless steel.

The plastic sleeve is expanded by screwing in the specific screw which presses the sleeve against the wall of the drilled hole.

The product description is given in Annex A.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the anchor is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchors of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

3.1 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	see Annex C 2

3.2 Mechanical resistance and stability (BWR 4)

Essential characteristic	Performance
Resistance to steel failure under tension loading	see Annex C 1
Resistance to steel failure under shear loading	see Annex C 1
Resistance to pull-out or concrete failure under tension loading (base material group a)	see Annex C 1
Resistance in any load direction without lever arm (base material group b, c, d)	see Annexes C 11 – C 26
Edge distance and spacing (base material group a)	see Annex B 4
Edge distance and spacing (base material group b, c, d)	see Annex B 5
Displacements under short-term and long-term loading	see Annex C 2
Durability	see Annex B 1 and B 2

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with European Assessment Document EAD 330284-00-0604 the applicable European legal act is: 97/463/EC.

The system to be applied is: 2+

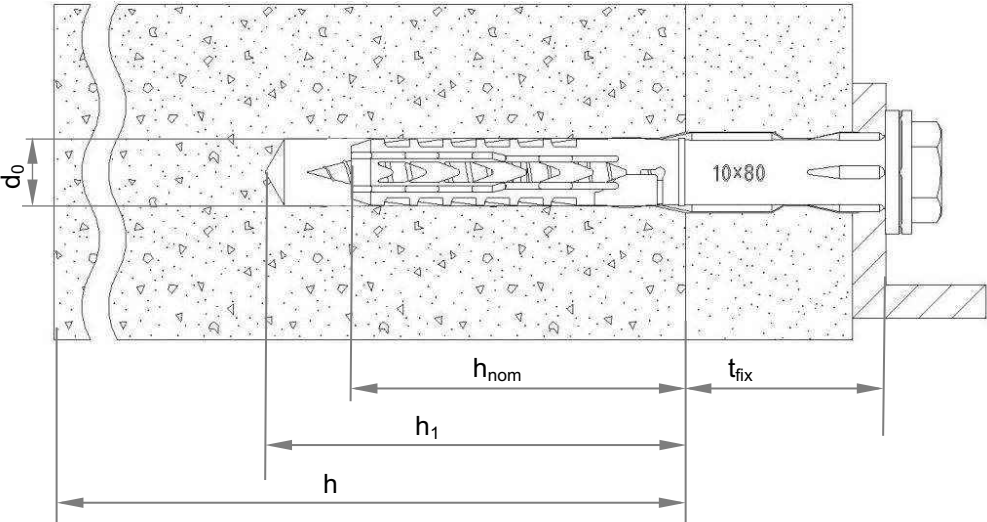
5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

The following standards and documents are referred to in this European Technical Assessment:

- EOTA European Assessment Document EAD 330284-00-0604, edition December 2020: Plastic anchors for redundant non-structural systems in concrete and masonry
- EOTA Technical Report TR 051, Edition April 2018: Recommendations for job site tests of plastic anchors and screws
- EOTA Technical Report TR 064, Edition May 2018: Design of plastic anchors in concrete and masonry
- EN 206:2013+A1:2016: Concrete – Specification, performance, production and conformity
- EN 771-1:2011+A1:2015: Specification for masonry units – Part 1: Clay masonry units
- EN 771-2:2011+A1:2015: Specification for masonry units – Part 2: Calcium silicate
- EN 771-3:2011+A1:2015: Specification for masonry units – Part 3: Aggregate concrete masonry units (dense and lightweight aggregates)
- EN 771-4:2011+A1:2015: Specification for masonry units – Part 4: autoclaved aerated concrete masonry units
- EN 998-2:2010: Specification for mortar for masonry - Part 2: Masonry mortar
- EN 1993-1-4:2006 + A1:2015: Eurocode 3: Design of steel structures – Part 1-4: General rules - Supplementary rules for stainless steels
- EN ISO 4042:2022: Fasteners – Electroplated coating systems

URD



Legend

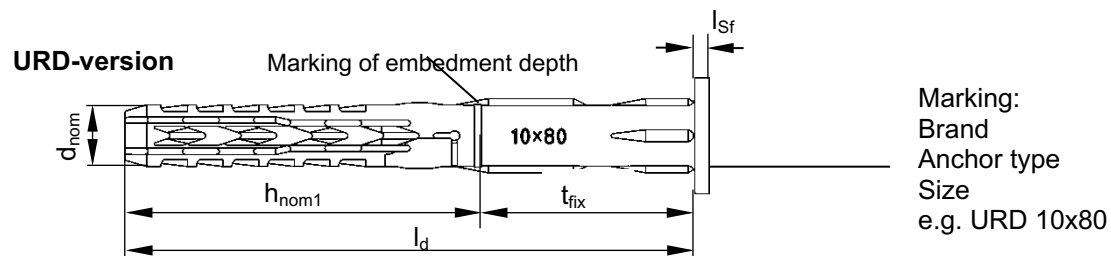
- h_{nom} = Overall plastic anchor embedment depth in the base material
- h_1 = Depth of drill hole to deepest point
- d_0 = Nominal drill hole diameter
- h = Thickness of member (base material)
- t_{fix} = Thickness of fixture and / or non-load-bearing layer

Figure not to scale

Frame fixing URD

Product description
Installed anchor

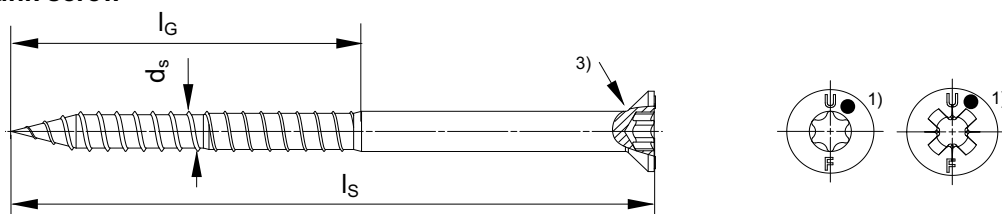
Anchor sleeves – flat collar versions of URD



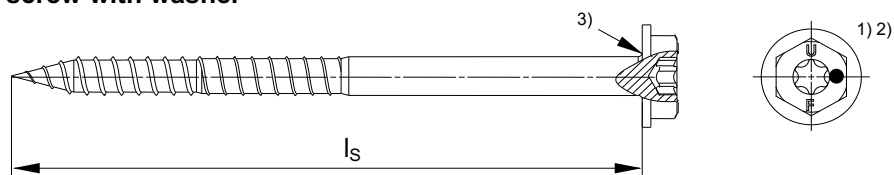
Countersunk sleeve version also available for both versions

Special Screws

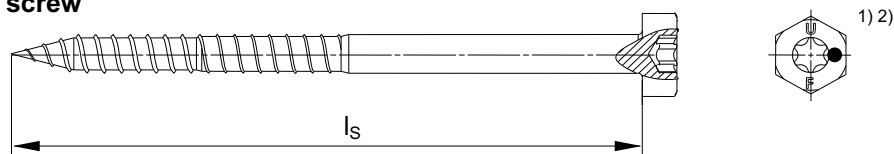
Countersunk screw



Hexagonal screw with washer



Hexagonal screw



- 1) Additional marking for the special screw, stainless steel version: e.g. "A4" or "R" or "A2".
- 2) Internal driving feature for TX bit is optional for hexagonal head screw.
- 3) Optional additional version with underhead ribs.

Figures not to scale

Frame fixing URD

Product description

Anchor types / special screws

Annex A 2

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Table A3.1: Dimensions

Anchor type	Anchor sleeve							Special screw		
	h_{nom1} [mm]	d_{nom} [mm]	t_{fix} [mm]	min. l_d [mm]	max. l_d [mm]	$l_{sf}^{1)}$ [mm]	$d_{sf}^{1)}$ [mm]	d_s [mm]	l_G [mm]	l_s [mm]
URD 8	50	8	≥ 1	51	360	1,8	15,0	6,0	≥ 59	$l_d + l_{sf}^{1)}) + d_s$
URD 10	50	10	≥ 1	51	360	2,2	18,5	7,0	≥ 57	$l_d + l_{sf}^{1)}) + d_s$

1) Only valid for flat collar version.

Table A3.2: Materials

Name	Material
Anchor sleeve	- Polyamide, PA6, colour grey, off-white
Special screw	- Galvanised steel gvz with Zn5/Ag or Zn5/An in accordance with EN ISO 4042 or - Galvanised steel gvz with Zn5/Ag or Zn5/An in accordance with EN ISO 4042 with additional organic layer (Zn5/Ag/T7 or Zn5/An/T7, respectively) in three layers (total layer thickness $\geq 6 \mu\text{m}$) or - Stainless steel "A2" of corrosion resistance class CRC II in accordance with EN 1993-1-4 or - Stainless steel "A4" or "R" of corrosion resistance class CRC III in accordance with EN 1993-1-4

Frame fixing URD

Product description

Dimensions and materials

Annex A 3

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Specifications of intended use

Anchorage subject to:

- Static and quasi-static loads.
- Redundant non-structural systems.

Base materials:

- Reinforced or unreinforced compacted normal weight concrete without fibres, strength classes $\geq$ C12/15 (base material group "a"), as per EN 206, see Annex C 1 and C 3.
- Thin-walled concrete components (e.g. weather shells) strength classes $\geq$ C12/15 (base material group "a"), as per EN 206, thickness $\geq$ 40 mm, see Annex C 1 and C 3.
- Solid brick masonry (base material group "b") as per EN 771-1, EN 771-2 or EN 771-3, see Annex C 3 – C 4, C 12 – C 18.
Note: The characteristic resistance is also valid for larger brick sizes and higher compressive strength of the masonry unit.
- Hollow or perforated brick masonry (base material group "c"), as per EN 771-1, EN 771-2 or EN 771-3, see Annex C 4 – C 10, C 18 – C 26.
- Unreinforced autoclaved aerated concrete (base material group "d") as per EN 771-4, see Annex C 10 and C 26.
- Mortar strength class of the masonry $\geq$ M2,5 in accordance with EN 998-2.
- For other comparable base materials of the base material group "a", "b", "c" and "d" the characteristic resistance of the anchor may be determined by job site tests in accordance with TR 051.

Temperature Range:

URD 8 and URD 10

- c: - 40 °C to 50 °C (max. short term temperature + 50 °C and max long term temperature + 30 °C)
- b: - 40 °C to 80 °C (max. short term temperature + 80 °C and max long term temperature + 50 °C)

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions: Special screw made of zinc coated steel or stainless steel.
- The specific screw made of galvanised steel or galvanised steel with an additional organic layer may also be used in structures subject to external atmospheric exposure, if the area of the head of the screw is protected against moisture and driving rain after mounting of the fixing unit in this way, that intrusion of moisture into the anchor shaft is prevented. Therefore there shall be an external cladding or a ventilated rainscreen mounted in front of the head of the screw and the head of the screw itself shall be coated with a soft plastic, permanently elastic bitumen-oil-combination coating (e.g. undercoating or body cavity protection for cars).
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist: Special screw made of stainless steel of corrosion resistance class CRC III.
Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

Frame fixing URD

Intended use
Specifications

Annex B 1

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Design:

- The anchorages are to be designed in accordance with TR 064 under the responsibility of an engineer experienced in anchorages and concrete/masonry work.
- Verifiable calculation notes and drawings shall be prepared taking account of the loads to be anchored, the nature and strength of the base materials and the dimensions of the anchorage members as well as of the relevant tolerances. The position of the anchor is indicated on the design drawings.

Installation:

- Hole drilling by the drilling method in accordance with Annex C 1 for base material group "a" and Annex C 12 - C 26 for base material group "b", "c" and "d".
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Installation temperature from URD 8 and URD 10: - 5 °C to + 40 °C
- Exposure to UV due to solar radiation of the not protected anchor by rendering ≤ 6 weeks.
- No ingress of water in the borehole at temperatures < 0 °C.

Frame fixing URD	Annex B 2 Appendix 7 / 37
Intended use Specifications	

Table B3.1: Installation parameters

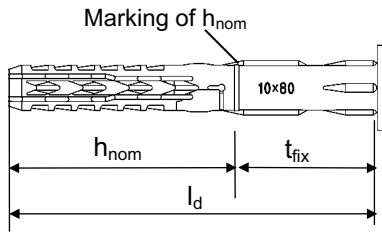
Anchor type			URD 8	URD 10
Drill hole diameter	d_0	= [mm]	8	10
Cutting diameter of drill bit	d_{cut}	≤ [mm]	8,45	10,45
Overall plastic anchor embedment depth in the base material ¹⁾²⁾	h_{nom}	≥ [mm]	50	50
Depth of drill hole to deepest point ¹⁾	h_1	≥ [mm]	60	60
Diameter of clearance hole in the fixture	d_f	≤ [mm]	8,50	10,50/12,50 ³⁾

¹⁾ See Annex A 1.

²⁾ For base material group "c": If the embedment depth is higher than h_{nom} given in the Table B3.1, job site tests have to be carried out in accordance with TR 051.

³⁾ See Table C2.1.

Table B3.2: Assignment of h_{nom} , l_d and t_{fix} for use in thin concrete slabs (e.g. weather resistant shells of external wall panels)

Anchor type		URD 10, $h_{nom} \geq 50$ mm		
Base material group "a" 		l_d [mm]	$t_{fix, min}$	$t_{fix, max}$
		[mm]	[mm]	[mm]
		52	1	2
		60	1	10
		80	21	30
		100	41	50
		120	61	70
		140	81	90
		160	101	110
		180	121	130
		200	141	150
		230	171	180
		260	201	210

Frame fixing URD

Intended use

Installation parameters, parameters for use in thin skins (e.g. weather resistant concrete skins of external wall panels)

Annex B 3

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**Table B4.1: Minimum thickness of member, edge distances and spacing in concrete –
base material group "a"**

Anchor type	Embedment depth h_{nom} [mm]	Concrete strength class	Minimum thickness of member h_{min} [mm]	Characteristic edge distance c_{cr} [mm]	Characteristic spacing s_{cr} [mm]	Minimum edge distances and spacing ¹⁾ c_{min}, s_{min} [mm]
URD 8	≥ 50	C12/15	100	70	70	$s_{min} = 70$ for $c \geq 70$ $c_{min} = 70$ for $s \geq 70$
		$\geq C16/20$		50	65	$s_{min} = 50$ for $c \geq 50$ $c_{min} = 50$ for $s \geq 50$
URD 10	≥ 50	C12/15	100 ²⁾	140	100	$s_{min} = 70$ for $c \geq 210$ $c_{min} = 85$ for $s \geq 100$
		$\geq C16/20$		100	90	$s_{min} = 50$ for $c \geq 150$ $c_{min} = 60$ for $s \geq 70$

1) Intermediate values by linear interpolation.

2) Also valid for thin concrete slabs, see Table B3.2 $h \geq 40$ mm, $h_{nom} = 50$ mm to 59 mm.

Fixing points with a spacing $a \leq s_{cr}$ are considered as a group with a maximum characteristic resistance $N_{Rk,p}$ according to Table C1.2. For a spacing $a > s_{cr}$ the anchors are considered as single anchors, each with a characteristic resistance $N_{Rk,p}$ according to Table C1.2.

Scheme of edge distances and spacing in concrete base material group "a"

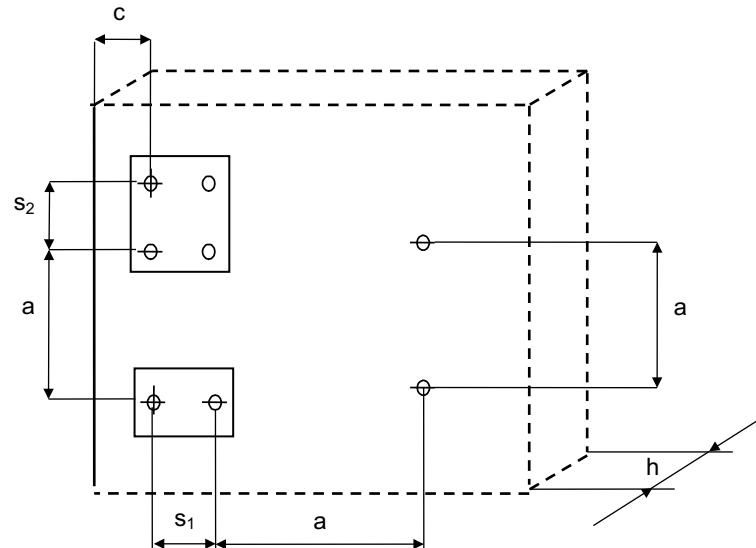


Figure not to scale

Frame fixing URD

Intended use

Minimum thickness of member, edge distances and spacing for use in concrete

Annex B 4

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Table B5.1: Minimum thickness of member, edge distances and spacing in solid and hollow or perforated masonry – base material group "b" and "c"

Anchor type			URD 8	URD 10
Minimum thickness of member ¹⁾	h_{min}	[mm]	100	100
Distance between anchor groups and / or single anchors	a_{min}	[mm]	250	250
Single anchor				
Minimum edge distance ²⁾	c_{min}	[mm]	100	100
Anchor group				
Minimum spacing perpendicular to free edge	$s_{1,min}$	[mm]	100 ²⁾	100 ²⁾
Minimum spacing parallel to free edge	$s_{2,min}$	[mm]	100 ²⁾	100 ²⁾
Minimum edge distance	c_{min}	[mm]	100 ²⁾	100 ²⁾

¹⁾ Thickness of member see Annex C 3 – C 26.

²⁾ For some anchor sizes and bricks Footnotes ⁷⁾ and ⁸⁾ on Annex C 11 have to be considered

Table B5.2: Minimum thickness of member, edge distances and spacing in unreinforced autoclaved aerated concrete - base material group "d"

Anchor type			URD 10
Compressive strength	$f_{cm,decl}$	[N/mm ²]	≥ 2
Nominal embedment depth	$h_{nom} \geq$	[mm]	50
Minimum thickness of member ¹⁾	h_{min}	[mm]	100
Distance between anchor groups and / or single anchors	a_{min}	[mm]	400
Single anchor			
Minimum edge distance	c_{min}	[mm]	100
Anchor group			
Minimum spacing perpendicular to free edge	$s_{1,min}$	[mm]	200
Minimum spacing parallel to free edge	$s_{2,min}$	[mm]	400
Minimum edge distance	c_{min}	[mm]	100

¹⁾ See Table C26.2.

Scheme of edge distances and spacing
in solid and hollow or perforated brick masonry
base material group "b" and "c"
and unreinforced autoclaved aerated concrete
base material group "d"

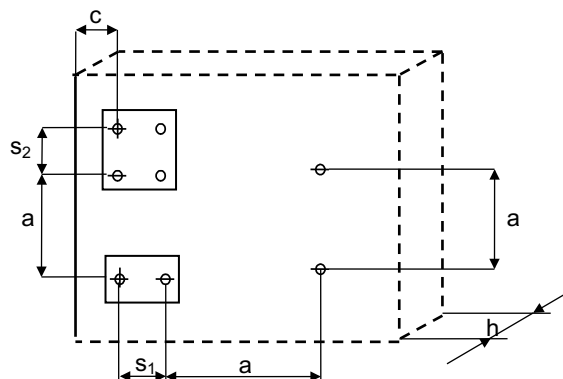


Figure not to scale

Frame fixing URD

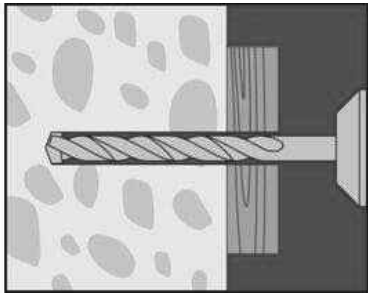
Intended use

Minimum thickness of member, edge distances and spacing for use in solid and hollow or perforated masonry and unreinforced autoclaved aerated concrete

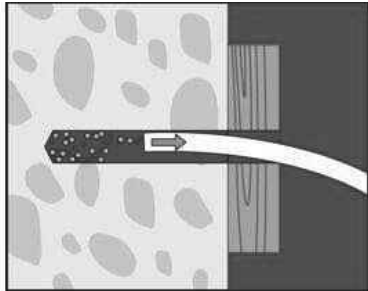
Annex B 5

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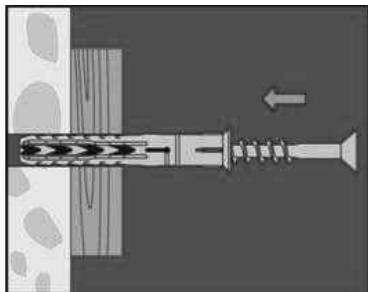
Installation instructions – pictures show e.g. use in anchorage base material group “a” concrete



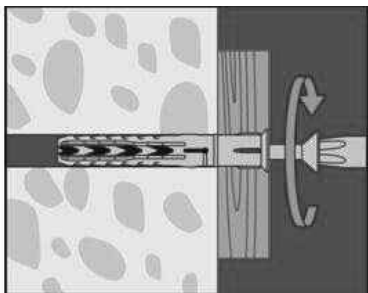
1. Drill the bore hole according to Table B3.1 using the drilling method described in the corresponding Annex C.



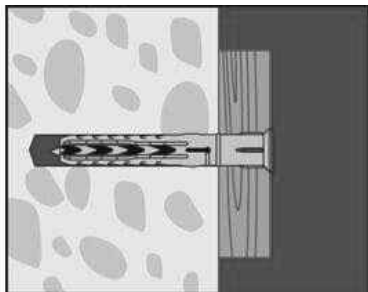
2. Base material group „a”, „b”, „d”: Remove dust from borehole.
Base material group “b” (e.g. perforated clay brick):
Dust from borehole must not be removed.



3. Insert anchor (screw and sleeve) by using a hammer until the collar of the plastic sleeve is flush with the surface of the fixture.



4. The screw is screwed-in until the head of the screw touches the sleeve. The anchor is correctly mounted, when the head of the screw fits tight on the surface and cannot be screwed-in any further.



5. Correctly installed anchor, e.g. in concrete.

Frame fixing URD

Intended use
Installation instructions

Annex B 6

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Table C1.1: Characteristic resistance of the screw					
Failure of expansion element (special screw)		URD 8		URD 10	
		galvanised steel	stainless steel	galvanised steel	stainless steel
Characteristic tension resistance	$N_{Rk,s}$ [kN]	14,8	14,3	21,7	21,7
Partial factor	γ_{Ms} ¹⁾ [-]	1,50	1,55	1,55	1,55
Characteristic shear resistance	$V_{Rk,s}$ [kN]	7,4	7,1	10,8	10,8
Partial factor	γ_{Ms} ¹⁾ [-]	1,25	1,29	1,29	1,29
Characteristic bending resistance of the screw					
Characteristic bending resistance	$M_{Rk,s}$ [Nm]	12,4	12,0	20,6	20,6
Partial factor	γ_{Ms} ¹⁾ [-]	1,25	1,25	1,29	1,29
¹⁾ In absence of other national regulations.					
Table C1.2: Characteristic resistance due to pullout-failure for use in concrete - base material group "a" ¹⁾					
Pull-out failure (plastic sleeve)		URD 8		URD 10	
Embedment depth h_{nom} [mm]		$\geq$		50	
Concrete $\geq$ C12/15					
Characteristic tension resistance 30/50 °C	$N_{Rk,p}$ [kN]		3,0	5,0	
Characteristic tension resistance 50/80 °C	$N_{Rk,p}$ [kN]		2,5 3,0 ³⁾	4,5	
Concrete $\geq$ C12/15 (e.g. weather resistant shells of external wall panels)					
Characteristic tension resistance 30/50 °C	$N_{Rk,p}$ [kN]	$h \geq 40$ mm	⁴⁾	3,5	
Characteristic tension resistance 50/80 °C	$N_{Rk,p}$ [kN]	$h \geq 40$ mm	⁴⁾	3,0	
Partial factor		γ_{Mc} ²⁾ [-]	1,8		
¹⁾ Drilling method: Hammer drilling. ²⁾ In absence of other national regulations. ³⁾ Only valid in concrete $\geq$ C16/20. ⁴⁾ No performance assessed.					
Frame fixing URD				Annex C 1 Appendix 12 / 37	
Performances					
Characteristic resistance and characteristic bending resistance of the screw Characteristic resistance for use in concrete					

Table C2.1: Displacements¹⁾ under tension and shear loading in concrete and masonry

Displacements under			Tension load ²⁾		Shear load ²⁾	
Anchor type	h_{nom} [mm]	F [kN]	δ_{NO} [mm]	$\delta_{N\infty}$ [mm]	δ_{vo} [mm]	$\delta_{v\infty}$ [mm]
URD 8	50	1,2	0,65	1,30	1,02	1,53
URD 10	50	2,0	1,29	2,58	1,15 ³⁾ /3,05 ⁴⁾	1,74 ³⁾ /4,58 ⁴⁾

1) Valid for all ranges of temperatures.

2) Intermediate values by linear interpolation.

3) Valid for diameter in the clearance hole $\leq 10,5$ mm (see Table B3.1).

4) Valid for diameter in the clearance hole = 12,5 mm (see Table B3.1).

Table C2.2: Displacements¹⁾ under tension and shear loading in unreinforced autoclaved aerated concrete

Displacements under				Tension load ²⁾		Shear load ²⁾	
Anchor type	$f_{cm,decl}$ [N/mm ²]	h_{nom} [mm]	F [kN]	δ_{NO} [mm]	$\delta_{N\infty}$ [mm]	δ_{vo} [mm]	$\delta_{v\infty}$ [mm]
URD 10	≥ 2	50	0,32	0,03	0,06	0,21	0,31

1) Valid for all ranges of temperatures.

2) Intermediate values by linear interpolation.

Table C2.3: Values under fire exposure in concrete C20/25 to C50/60 in any load direction (no permanent centric tension load, shear load without lever arm) fastening of façade systems

Anchor type	Fire resistance class	$F_{Rk,fi,90}$	$\gamma_{M,fi}$ ¹⁾
URD 10	R 90	0,8 kN	1,0

1) In absence of other national regulations.

If one-side fire load, see table B4.1 for edge distance.

In case of fire attack from more than one side the minimum edge distance shall be $c \geq 300$ mm, $c \geq 2 \cdot h_{ef}$; the bigger value is decisive.

Frame fixing URD

Performances

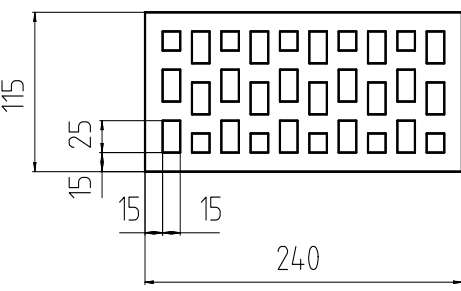
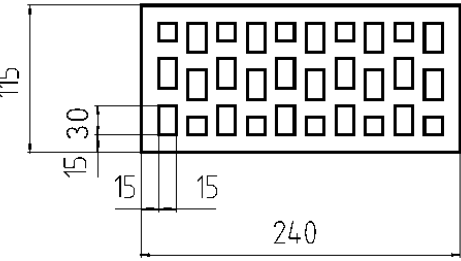
Displacements under tension and shear loading in concrete, masonry and autoclaved aerated concrete, fire resistance in concrete

Annex C 2

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Table C3.1: Summary of concrete – base material group "a" and solid bricks – base material group "b" ¹⁾					
Base material	Format	Dimensions (L x W x H) [mm]	Mean compressive strength as per EN 771 [N/mm²]	Bulk density ρ [kg/dm³]	See Annex
Concrete ≥ C12/15 as per EN 206					C 1
Weather resistant shells of external wall panels ≥ C12/15 as per EN 206					C 1
Clay brick Mz as per EN 771-1, e.g. Schlagmann, DE	3 DF	240 x 175 x 113	≥ 10	≥ 1,8	C 12
Clay brick Mz as per EN 771-1, e.g. Wienerberger, DK	DF	240 x 115 x 52	≥ 10	≥ 1,8	C 12
Clay brick Mz as per EN 771-1, e.g. Schlagmann, DE e.g. Ebersdobler, DE	NF	240 x 115 x 71	≥ 10	≥ 1,8	C 13
Clay brick Mz as per EN 771-1, e.g. Schlagmann, DE	2 DF	240 x 115 x 113	≥ 10	≥ 2,4	C 14
Calcium silicate solid brick KS as per EN 771-2, e.g. KS Wemding, DE	NF	240 x 115 x 71	≥ 10	≥ 1,8	C 14 C 15
Calcium silicate solid brick KS as per EN 771-2, e.g. KS Wemding, DE	12 DF	495 x 175 x 240	≥ 10	≥ 1,8	C 15
Lightweight solid brick Vbl as per EN 771-3, e.g. KLB, DE	2 DF	240 x 115 x 113	≥ 2,5	≥ 1,2	C 15
Lightweight solid brick Vbl as per EN 771-3, e.g. KLB, DE	8 DF	490 x 115 x 240	≥ 2,5	≥ 1,0	C 15 C 16
Lightweight solid brick Vbl as per EN 771-3, e.g. KLB, DE	8 DF	245 x 240 x 240	≥ 2,5	≥ 1,4	C16 C17
1) Vertically perforation ≤ 15 %; cross section reduced by perforation vertically to the resting area.					
Frame fixing URD				Annex C 3 Appendix 14 / 37	
Performances Summary of base materials concrete and solid bricks					

Table C4.1: Summary of solid bricks – base material group "b" ¹⁾					
Base material	Format	Dimensions (L x W x H) [mm]	Mean compressive strength as per EN 771 [N/mm ²]	Bulk density ρ [kg/dm ³]	See Annex
Lightweight solid brick concrete Vbl as per EN 771-3, <i>e.g. Tarmac, UK</i>	-	440 x 100 x 210	$\geq 2,5$	$\geq 1,4$	C 17
Solid brick normal concrete Vbn as per EN 771-3, <i>e.g. Adolf Blatt, DE</i>	-	240 x 245 x 240	≥ 5	$\geq 1,8$	C 17
Lightweight solid brick Vbn as per EN 771-3, <i>e.g. Tarmac UK</i>	-	440 x 100 x 210	$\geq 7,5$	$\geq 1,8$	C 18

Table C4.2: Summary of hollow or perforated bricks – base material group "c" ¹⁾				
Base material	Format/ Dimensions (L x W x H) [mm]	Brick drawing [mm]	Mean com- pressive strength as per EN 771 [N/mm ²] / bulk density ρ [kg/dm ³]	See Annex
Perforated clay brick HLz Form B, as per EN 771-1, <i>e.g. Wienerberger, DE</i>	2 DF 240 x 115 x 113		$\geq 10 / \geq 1,2$	C 18
Perforated clay brick HLz as per EN 771-1, <i>e.g. Wienerberger, DE</i>	2 DF 240 x 115 x 113		$\geq 10 / \geq 1,0$	C 19

¹⁾ Vertically perforation > 15 % and ≤ 50 %, cross section reduced by perforation vertically to the resting area.

Figures not to scale

Frame fixing URD	Annex C 4 Appendix 15 / 37
Performances Summary of base materials solid bricks and hollow or perforated bricks	

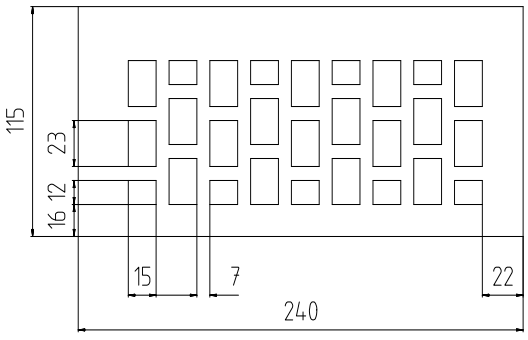
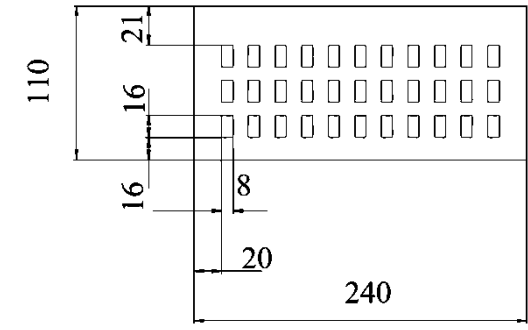
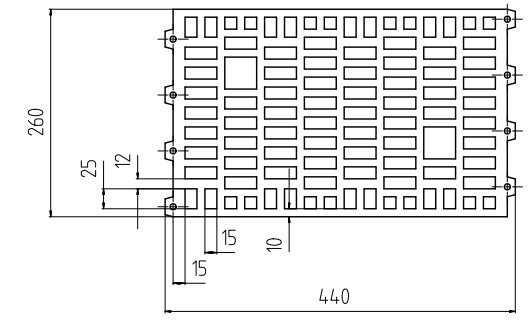
Table C5.1: Summary of hollow or perforated bricks – base material group "c" ¹⁾				
Base material	Format/ Dimensions (L x W x H)	Brick drawing	Mean com- pressive strength as per EN 771 [N/mm²] / bulk density ρ [kg/dm³]	See Annex
	[mm]	[mm]		
Perforated clay brick VHLz as per EN 771-1, e.g. <i>Wienerberger, DE</i>	2 DF 240 x 115 x 113		≥ 12,5 / ≥ 1,6	C 19
Perforated clay brick HLz as per EN 771 -1, e.g. <i>Wienerberger, BS, DE</i>	DF 240 x 110 x 52		≥ 10 / ≥ 1,5	C 19
Perforated clay brick HLz as per EN 771 -1, e.g. <i>Schlagmann, DE</i>	10 DF 440 x 260 x 240		≥ 5 / ≥ 0,9	C 20
¹⁾ Vertically perforation > 15 % and ≤ 50 %, cross section reduced by perforation vertically to the resting area.				
Figures not to scale				
Frame fixing URD			Annex C 5 Appendix 16 / 37	
Performances Summary of base materials hollow or perforated bricks				

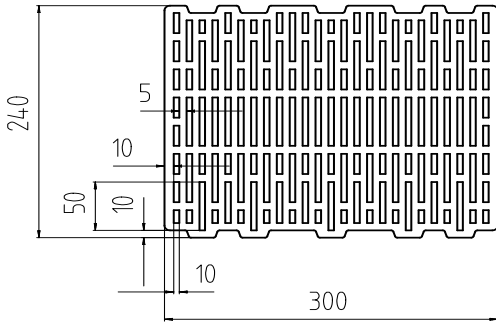
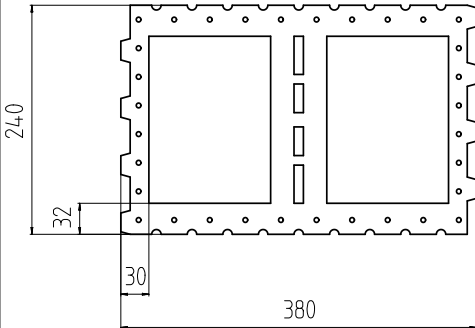
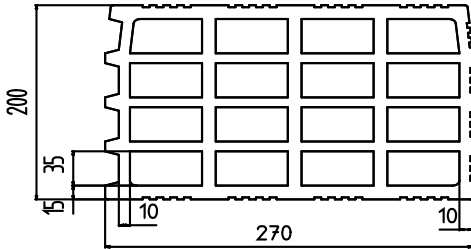
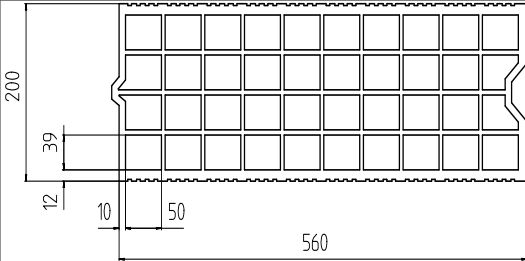
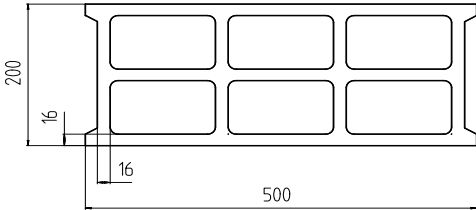
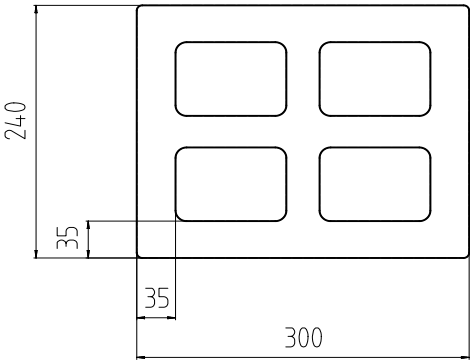
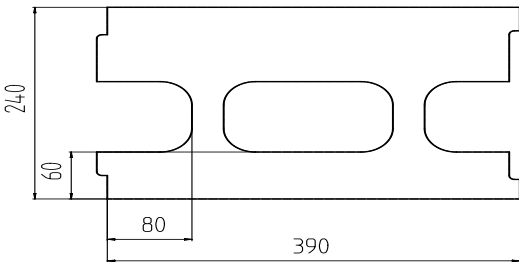
Table C6.1: Summary of hollow or perforated bricks – base material group "c" ¹⁾				
Base material	Format/ Dimensions (L x W x H)	Brick drawing	Mean compressive strength as per EN 771 [N/mm ²] / bulk density ρ [kg/dm ³]	See Annex
	[mm]	[mm]		
Perforated clay brick HLz as per EN 771-1, e.g. <i>Schlagmann Poroton T14, DE</i>	10 DF 240 x 300 x 240		≥ 5 / ≥ 0,7	C 20
Perforated clay brick HLz as per EN 771-1, e.g. <i>Schlagmann Planfüllziegel, DE</i>	12 DF 380 x 240 x 240		≥ 2,5 / ≥ 0,7	C 20
Perforated clay brick HLz as per EN 771-1, e.g. <i>Imerys Gelimatic, FR</i>	500 x 200 x 270		≥ 5 / ≥ 0,6	C 21
Perforated clay brick HLz as per EN 771-1, e.g. <i>Imerys Optibric, FR</i>	560 x 200 x 275		≥ 5 / ≥ 0,6	C 21
¹⁾ Vertically perforation > 15 % and ≤ 50 %, cross section reduced by perforation vertically to the resting area.				
Figures not to scale				
Frame fixing URD			Annex C 6 Appendix 17 / 37	
Performances Summary of base materials hollow or perforated bricks				

Table C7.1: Summary of hollow or perforated bricks – base material group "c" ¹⁾				
Base material	Format/ Dimensions (L x W x H)	Brick drawing	Mean com- pressive strength as per EN 771 [N/mm²] / bulk density ρ [kg/dm³]	See Annex
	[mm]	[mm]		
Perforated clay brick HLz as per EN 771-1, e.g. Bouyer Leroux BGV, FR	570 x 200 x 315		≥ 5 / ≥ 0,6	C 21
Perforated clay brick HLz as per EN 771-1, e.g. Wienerberger Porotherm 30 R, FR	370 x 300 x 250		≥ 7,5 / ≥ 0,7	C 22
Perforated clay brick HLz as per EN 771-1, e.g. Wienerberger Porotherm GF R20, FR	500 x 200 x 275		≥ 5 / ≥ 0,7	C 22
¹⁾ Vertically perforation > 15 % and ≤ 50 %, cross section reduced by perforation vertically to the resting area.				
Figures not to scale				
Frame fixing URD			Annex C 7 Appendix 18 / 37	
Performances Summary of base materials hollow or perforated bricks				

Table C8.1: Summary of hollow or perforated bricks – base material group "c" ¹⁾				
Base material	Format/ Dimensions (L x W x H)	Brick drawing	Mean com- pressive strength as per EN 771 [N/mm²] / bulk density ρ [kg/dm³]	See Annex
	[mm]	[mm]		
Perforated clay brick HLz as per EN 771-1, e.g. <i>Terreal Calibric</i> , <i>FR</i>	500 x 200 x 220		≥ 5 / ≥ 0,7	C 22
Hollow calcium silicate brick KSL as per EN 771-2, e.g. <i>KS Wemding</i> , <i>DE</i>	2 DF 240 x 115 x 113		≥ 7,5 / ≥ 1,4	C 23
Hollow calcium silicate brick KSL as per EN 771-2, e.g. <i>KS Wemding</i> , <i>DE</i>	3 DF 240 x 175 x 113		≥ 7,5 / ≥ 1,4	C 23
Hollow calcium silicate brick KSL as per EN 771-2, e.g. <i>KS Wemding</i> , <i>DE</i>	5 DF 300 x 240 x 113		≥ 7,5 / ≥ 1,4	C 23
¹⁾ Vertically perforation > 15 % and ≤ 50 %, cross section reduced by perforation vertically to the resting area. Figures not to scale				
Frame fixing URD			Annex C 8 Appendix 19 / 37	
Performances Summary of base materials hollow or perforated bricks				

Table C9.1: Summary of hollow or perforated bricks – base material group "c" ¹⁾				
Base material	Format/ Dimensions (L x W x H)	Brick drawing	Mean com- pressive strength as per EN 771 [N/mm²] / bulk density ρ [kg/dm³]	See Annex
	[mm]	[mm]		
Hollow calcium silicate brick KSL as per EN 771-2, e.g. <i>KS Wemding,</i> <i>P10, DE</i>	495 x 98 x 245		≥ 2,5 / ≥1,2	C 24
Hollow brick light- weight concrete Hbl as per EN 771-3, e.g. <i>KLB, DE</i>	300 x 240 x 240		≥ 2,5 / ≥ 1,4	C 24
Hollow brick light- weight concrete Hbl as per EN 771-3, e.g. <i>Roadstone masonry, IE</i>	440 x 210 x 215		≥ 2,5 / ≥ 1,2	C 24
Hollow brick light- weight concrete Hbl as per EN 771-3, e.g. <i>KLB, DE</i>	360 x 240 x 240		≥ 2,5 / ≥ 1,0	C 25
¹⁾ Vertically perforation > 15 % and ≤ 50 %, cross section reduced by perforation vertically to the resting area.				
Figures not to scale				
Frame fixing URD			Annex C 9 Appendix 20 / 37	
Performances Summary of base materials hollow or perforated bricks				

Table C10.1: Summary of hollow or perforated bricks – base material group "c" ¹⁾				
Base material	Format/ Dimensions (L x W x H)	Brick drawing	Mean compressive strength as per EN 771 [N/mm ²] / bulk density ρ [kg/dm ³]	See Annex
	[mm]	[mm]		
Hollow brick light-weight concrete Hbl as per EN 771-3, <i>e.g. Sepa Parpaing, FR</i>	500 x 200 x 200		≥ 2,5 / ≥ 0,9	C 25
Hollow brick normal concrete Hbn as per EN 771-3, <i>e.g. Adolf Blatt, DE</i>	300 x 240 x 240		≥ 2,5 / ≥ 1,6	C 25
Heat insulation brick WDB <i>e.g. Gisoton, DE</i>	390 x 240 x 240		≥ 2,5 / ≥ 0,7	C 26

¹⁾ Vertically perforation > 15 % and ≤ 50 %, cross section reduced by perforation vertically to the resting area.

Table C10.2: Summary of autoclaved aerated concrete – base material group "d"					
Base material	Format	Dimensions (L x W x H)	Mean compressive strength as per EN 771	Bulk density ρ	See Annex
	[mm]	[mm]	[N/mm²]	[kg/dm³]	
Unreinforced autoclaved aerated concrete, as per EN 771-4					C26
Figures not to scale					
Frame fixing URD				Annex C 10 Appendix 21 / 37	
Performances Summary of base materials hollow or perforated bricks and autoclaved aerated concrete					

Footnotes for Annex C 12 – C 26

- 1) In absence of other national regulations.
- 2) Only valid for temperature range 30/50 °C.
- 3) Only valid for edge distance c ≥ 150 mm; intermediate values by linear interpolation.
- 4) Only valid for edge distance c ≥ 200 mm; intermediate values by linear interpolation.
- 5) Only valid for edge distance c ≥ 150 mm for temperature range 30/50 °C; intermediate values by linear interpolation.
- 6) Only valid for edge distance c ≥ 200 mm for temperature range 30/50 °C; intermediate values by linear interpolation.
- 7) Only valid for spacing s ≥ 250 mm
- 8) Only valid for spacing s ≥ 250 mm for temperature range 30/50 °C
- 9) The compressive strength of the single brick must not be less than 80 % of the mean compressive strength.
- 10) No performance assessed.
- 11) The characteristic resistance F_{Rk} is taken from the lower compressive strength of the masonry unit.
- 12) If the compressive strength of the base material according to EN 771-1, EN 771-2 or EN 771-3 on the construction side is lower than the mean compressive strength given in the tables according to Annex C 12 – C 26, F_{Rk} shall be calculated as follows:

$$F_{Rk, construction\ site} = F_{Rk}\ (Table\ C.\ "X") \cdot \frac{Mean\ compressive\ strength\ (construction\ site)}{Mean\ compressive\ strength\ (Table\ C.\ "X")}$$

Table C12.1: Characteristic resistance $F_{Rk}^{(12)}$ in [kN] for use in solid masonry - base material group "b"

Base material; bulk density [kg/dm³] [Supplier Title, country] Geometry, DF or nominal Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771 / Minimum compressive strength single brick ⁽⁹⁾ [N/mm²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		≥ 50	≥ 50
Clay brick Mz; $\rho \geq 1,8$ as per EN 771-1 <i>e.g. Schlagmann, DE</i> 3 DF (240x175x113) Hammer drilling	10/8	0,90 1,20⁽²⁾	0,90 1,50⁽⁴⁾
	12,5/10	1,20 1,50⁽²⁾	1,20 1,50⁽⁴⁾ 2,00⁽⁶⁾
	15/12	1,50 2,00⁽²⁾	1,50 2,00⁽⁴⁾ 2,50⁽⁶⁾
	20/16	2,00 2,50⁽²⁾	2,00 2,50⁽⁴⁾ 3,00⁽⁶⁾
	24,7	2,50 3,00⁽²⁾	2,50 3,50⁽⁴⁾ 4,00⁽⁶⁾
Clay brick Mz; $\rho \geq 1,8$ as per EN 771-1 <i>e.g. Wienerberger, DK</i> DF (240x115x52) Hammer drilling	10/8	0,90⁽⁷⁾	10)
	12,5/10	0,90⁽⁷⁾ 1,20⁽⁸⁾	1,20⁽⁷⁾
	15/12	1,20⁽⁷⁾ 1,50⁽⁸⁾	1,20⁽⁷⁾ 1,50⁽⁸⁾
	20/16	1,50⁽⁷⁾ 2,00⁽⁸⁾	1,50⁽⁷⁾ 2,00⁽⁸⁾
	25/20	2,00⁽⁷⁾ 2,50⁽⁸⁾	2,00⁽⁷⁾ 2,50⁽⁸⁾
	26,7	2,00⁽⁷⁾ 2,50⁽⁸⁾	2,00⁽⁷⁾ 2,50⁽⁸⁾
	35/28	3,00⁽⁷⁾	3,00⁽⁷⁾ 3,50⁽⁸⁾
	45/36	3,00⁽⁷⁾	4,00⁽⁷⁾ 4,50⁽⁸⁾
Partial factor $\gamma_{Mm}^{(1)}$ [-]		2,5	

Footnotes see Annex C 11.

Frame fixing URD

Performances

Characteristic resistance for use in solid masonry

Annex C 12

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Table C13.1: Characteristic resistance $F_{Rk}^{12)}$ in [kN] for use in solid masonry - base material group "b"			
Base material; bulk density [kg/dm³] [Supplier Title, country] Geometry, DF or nominal Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771 / Minimum compressive strength single brick ⁹⁾ [N/mm²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		≥ 50	≥ 50
Clay brick Mz; $\rho \geq 1,8$ as per EN 771-1 e.g. Schlagmann, DE e.g. Ebersdobler, DE NF (240x115x71) Hammer drilling	10/8	0,75 ⁷⁾ 0,90 ⁸⁾	10)
	12,5/10	0,90 ⁷⁾ 1,20 ⁸⁾	0,90 ⁷⁾ 1,20 ³⁾⁷⁾
	15/12	1,20 ⁷⁾ 1,50 ⁸⁾	1,20 ⁷⁾ 1,50 ⁸⁾
	18,5/-	1,20 ⁷⁾ 1,50 ⁸⁾	1,20 ⁷⁾ 1,50 ⁸⁾
	20/16	1,50 ⁷⁾ 2,00 ⁸⁾	1,50 ⁷⁾ 2,00 ⁸⁾
	25/20	2,00 ⁷⁾ 2,50 ⁸⁾	2,00 ⁷⁾ 2,50 ⁸⁾
	35/28	2,50 ⁷⁾ 3,00 ⁸⁾	3,00 ⁷⁾ 3,50 ⁸⁾
	35,4	3,00 ⁷⁾	3,00 ⁷⁾ 3,50 ⁸⁾
	38,4	11)	3,50 ⁷⁾ 4,00 ⁸⁾
	45/36	11)	4,00 ⁷⁾ 4,50 ⁸⁾
	60/48	11)	5,00 ⁷⁾
	60,7	11)	5,00 ⁷⁾
Partial factor $\gamma_{Mm}^{1)}$ [-]		2,5	
Footnotes see Annex C 11.			
Frame fixing URD			Annex C 13 Appendix 24 / 37
Performances Characteristic resistance for use in solid masonry			

Table C14.1: Characteristic resistance $F_{Rk}^{12)}$ in [kN] for use in solid masonry - base material group "b"			
Base material; bulk density [kg/dm³] [Supplier Title, country] Geometry, DF or nominal Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771 / Minimum compressive strength single brick ⁹⁾ [N/mm²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		≥ 50	≥ 50
Clay brick Mz; $\rho \geq 2,2$ as per EN 771-1 e.g. Schlagmann, DE 2 DF (240x115x113) Hammer drilling	10/8	10)	1,20 ⁷⁾
	12,5/10	10)	1,50 ⁷⁾
	15/12	10)	1,50 ⁷⁾ 2,00 ⁸⁾
	20/16	10)	2,00 ⁷⁾ 2,50 ⁸⁾
	25/20	10)	3,00 ⁷⁾
	26,4	10)	3,00 ⁷⁾ 3,50 ⁸⁾
Calcium silicate solid brick KS; $\rho \geq 1,8$ as per EN 771-2 e.g. KS Wemding, DE NF (240x115x71) Hammer drilling	10/8	1,20	0,90 ⁷⁾ 2,00 ⁴⁾⁷⁾
	12,5/10	1,20 1,50 ²⁾	1,20 ⁷⁾ 2,00 ⁴⁾⁷⁾ 2,50 ⁶⁾⁸⁾
	15/12	1,50 2,00 ²⁾	1,50 ⁷⁾ 2,50 ⁴⁾⁷⁾ 3,00 ⁶⁾⁸⁾
	20/16	2,00 2,50 ²⁾	2,00 ⁷⁾ 3,50 ⁴⁾⁷⁾ 4,00 ⁶⁾⁸⁾
	25/20	2,50 3,00 ²⁾	2,50 ⁷⁾ 4,50 ⁴⁾⁷⁾ 5,00 ⁶⁾⁸⁾
	27,0	2,50 3,00 ²⁾	3,00 ⁷⁾ 5,00 ⁴⁾⁷⁾
	35/28	3,00	11)
	37,4/-	3,00	11)
Partial factor $\gamma_{Mm}^{1)}$ [-]		2,5	
Footnotes see Annex C 11.			
Frame fixing URD			Annex C 14 Appendix 25 / 37
Performances Characteristic resistance for use in solid masonry			

Table C15.1: Characteristic resistance $F_{Rk}^{12)}$ in [kN] for use in solid masonry - base material group "b"

Base material; bulk density [kg/dm ³] [Supplier Title, country] Geometry, DF or nominal Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771 / Minimum compressive strength single brick ⁹⁾ [N/mm ²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		≥ 50	≥ 50
Calcium silicate solid brick KS; $\rho \geq 2,0$ as per EN 771-2 <i>e.g. KS Wemding, DE</i> NF (240x115x71) Hammer drilling	10/8	1,20 1,50²⁾	0,90
	12,5/10	1,20 1,50²⁾	1,20
	15/12	1,50 2,00²⁾	1,20 1,50²⁾
	20/16	2,00 2,50²⁾	1,50 2,00²⁾
	25/20	2,50 3,00²⁾	2,00 2,50²⁾
	35/28	3,00	3,00 3,50²⁾
	37,2/-	3,00	3,00 3,50²⁾
	45/36	¹¹⁾	4,00 4,50²⁾
	54,6/-	¹¹⁾	5,00
Calcium silicate solid brick KS; $\rho \geq 2,0$ as per EN 771-2 <i>e.g. KS Wemding, DE</i> 12 DF (495x175x240) Hammer drilling	10/8	1,50	2,00
	12,5/10	1,50 2,00²⁾	2,50 3,00²⁾
	15/12	2,00 2,50²⁾	3,00 3,50²⁾
	20/16	3,00	4,00 4,50²⁾
	25/20	3,00	5,00
	33,9/-	3,00	5,00
Lightweight solid brick Vbl; $\rho \geq 1,2$ as per EN 771-3 <i>e.g. KLB, DE</i> 2 DF (240x115x113) Hammer drilling	2,5/2	0,50⁷⁾	0,75⁷⁾ 0,90⁸⁾
	2,7/-	0,75⁷⁾ 0,90⁸⁾	¹⁰⁾
Lightweight solid brick Vbl; $\rho \geq 1,0$ as per EN 771-3 <i>e.g. KLB, DE</i> 8 DF (490x115x240) Hammer drilling	2,5/2	1,20	¹⁰⁾
	3,1/-	1,50	¹⁰⁾
Partial factor $\gamma_{Mm}^{1)}$ [-]		2,5	

Footnotes see Annex C 11.

Frame fixing URD

Performances

Characteristic resistance for use in solid masonry

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Table C16.1: Characteristic resistance $F_{Rk}^{12)}$ in [kN] for use in solid masonry - base material group "b"

Base material; bulk density [kg/dm³] [Supplier Title, country] Geometry, DF or nominal Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771 / Minimum compressive strength single brick ⁹⁾ [N/mm²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		≥ 50	≥ 50
Lightweight solid brick Vbl; $\rho \geq 1,2$ as per EN 771-3 <i>e.g. KLB, DE</i> 8 DF (490x115x240) Hammer drilling	2,5/2	10)	1,20
Lightweight solid brick Vbl; $\rho \geq 1,6$ as per EN 771-3 <i>e.g. KLB, DE</i> 8 DF (490x115x240) Hammer drilling	2,5/2	10)	0,90⁷⁾ 1,20⁸⁾
	5/4	10)	2,00⁷⁾ 2,00⁸⁾ 2,50⁵⁾⁸⁾
	7,5/6	10)	2,50⁷⁾ 3,00³⁾⁷⁾ 3,50⁵⁾⁸⁾
	9,0/-	10)	2,50⁷⁾ 3,50³⁾⁷⁾ 4,00⁵⁾⁸⁾
Lightweight solid brick Vbl; $\rho \geq 1,8$ as per EN 771-3 <i>e.g. KLB, DE</i> 8 DF (490x240x115) Hammer drilling	5/4	1,50⁷⁾ 2,00⁵⁾⁸⁾	10)
	7,5/6	2,00⁷⁾ 2,50³⁾⁷⁾	10)
	10/8	2,50⁷⁾ 3,00³⁾⁷⁾	10)
	12,5/10	2,50⁷⁾	10)
	13,42/-	3,00⁷⁾	10)
Lightweight solid brick Vbl; $\rho \geq 1,4$ as per EN 771-3 <i>e.g. KLB, DE</i> 8 DF (245x240x240) Hammer drilling	5/4	0,50⁷⁾ 0,60⁸⁾	2,00⁷⁾
	7,5/6	0,75⁷⁾ 0,90⁸⁾	2,50⁷⁾
	8,65/-	0,90⁷⁾	2,50⁷⁾
Partial factor	$\gamma_{Mm}^{1)}$ [-]	2,5	

Footnotes see Annex C 11.

Frame fixing URD

Performances

Characteristic resistance for use in solid masonry

Annex C 16

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Table C17.1: Characteristic resistance $F_{Rk}^{12)}$ in [kN] for use in solid masonry - base material group "b"

Base material; bulk density [kg/dm³] [Supplier Title, country] Geometry, DF or nominal Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771 / Minimum compressive strength single brick ⁹⁾ [N/mm²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		≥ 50	≥ 50
Lightweight solid brick Vbl; $\rho \geq 1,6$ as per EN 771-3 <i>e.g. KLB, DE</i> 8 DF (245x240x240) Hammer drilling	2,5/2	10)	1,20⁷⁾ 1,50⁵⁾⁸⁾
	5/4	10)	2,00⁷⁾ 2,50³⁾⁷⁾ 3,00⁵⁾⁸⁾
	7,5/6	10)	2,50⁷⁾ 4,00³⁾⁷⁾ 4,50⁵⁾⁸⁾
	10/8	10)	2,50⁷⁾ 4,00³⁾⁷⁾ 4,50⁵⁾⁸⁾
	11,0/-	10)	11)
Lightweight solid brick Vbl; $\rho \geq 1,4$ as per EN 771-3, <i>e.g. Tarmac, UK</i> (440x100x215) Hammer drilling	2,5/2	10)	0,90⁷⁾
	5/4	10)	1,50⁷⁾
	7,3/-	10)	2,00⁷⁾ 2,50³⁾⁷⁾ 3,00⁵⁾⁸⁾
Solid brick normal concrete, Vbn; $\rho \geq 1,8$ as per EN 771-3 <i>e.g. Adolf Blatt, DE</i> (240x245x240) Hammer drilling	5/4	1,50⁷⁾	1,50⁷⁾ 2,00⁸⁾
	7,5/6	2,00⁷⁾ 2,50⁸⁾	2,50⁷⁾ 3,00⁵⁾⁸⁾
	10/8	3,00⁷⁾	3,00⁷⁾ 3,50³⁾⁷⁾ 4,00⁵⁾⁸⁾
	12,5/10	3,00⁷⁾	3,50⁷⁾ 4,00³⁾⁷⁾ 5,00⁵⁾⁸⁾
	15/12	3,00⁷⁾	3,50⁷⁾ 5,00³⁾⁷⁾ 5,00⁵⁾⁸⁾
	17,0/-	3,00⁷⁾	4,00⁷⁾ 5,00³⁾⁷⁾ 5,00⁵⁾⁸⁾
Partial factor	$\gamma_{Mm}^{1)}$ [-]	2,5	

Footnotes see Annex C 11.

Frame fixing URD

Performances

Characteristic resistance for use in solid masonry

Annex C 17

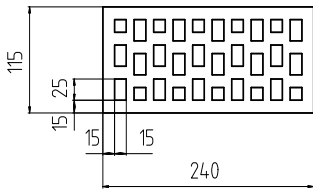
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Table C18.1: Characteristic resistance $F_{Rk}^{12)}$ in [kN] for use in solid masonry - base material group "b"

Base material; bulk density [kg/dm ³] [Supplier Title, country] Geometry, DF or nominal Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771 / Minimum compressive strength single brick ⁹⁾ [N/mm ²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		≥ 50	≥ 50
Solid brick normal concrete Vbn; $\rho \geq 1,8$ as per EN 771-3 e.g. <i>Tarmac, UK</i> (440x100x215) Hammer drilling	7,5/6	10)	1,50⁷⁾ 2,00⁸⁾
	10/8	10)	2,00⁷⁾ 2,50⁸⁾
	12,5/10	10)	2,50⁷⁾ 3,00⁵⁾⁸⁾
	15/12	10)	3,00⁷⁾ 3,50⁵⁾⁸⁾
	18,0/-	10)	3,50⁷⁾ 4,00³⁾⁷⁾ 4,50⁵⁾⁸⁾
Partial factor $\gamma_{Mm}^{1)}$ [-]		2,5	

Footnotes see Annex C 11.

Table C18.2: Characteristic resistance $F_{Rk}^{12)}$ in [kN] for use in hollow or perforated brick masonry – base material group "c"

Base material; bulk density [kg/dm ³] [Supplier Title, country] Geometry, DF or nominal Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771 / Minimum compressive strength single brick ⁹⁾ [N/mm ²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		50	50
Perforated clay brick HLz; $\rho \geq 1,2$ Form B, as per EN 771-1 e.g. <i>Wienerberger, DE</i>  2 DF (240x115x113) Rotary drilling	10/8	0,40⁷⁾ 0,50⁸⁾	0,90⁷⁾
	12,5/10	0,60⁷⁾	1,20⁷⁾
	15/12	0,60⁷⁾ 0,75⁸⁾	1,50⁷⁾
	20/16	0,90⁷⁾	2,00⁷⁾
	25/20	1,20⁷⁾	2,50⁷⁾
	26,7/-	1,20⁷⁾ 1,50⁸⁾	2,50⁷⁾
Partial factor $\gamma_{Mm}^{1)}$ [-]		2,5	

Footnotes see Annex C 11.

Frame fixing URD

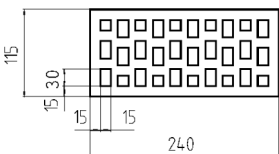
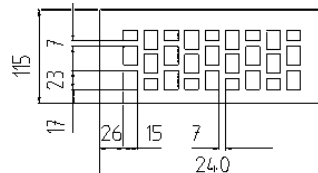
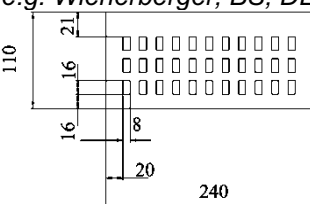
Performances

Characteristic resistance for use in solid, hollow or perforated masonry

Annex C 18

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Table C19.1: Characteristic resistance $F_{Rk}^{12)}$ in [kN] for use in hollow or perforated brick masonry – base material group "c"

Base material; bulk density [kg/dm³] [Supplier Title, country] Geometry, DF or nominal Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771 / Minimum compressive strength single brick ⁹⁾ [N/mm²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		50	50
Perforated clay brick HLz; $\rho \geq 1,0$ as per EN 771-1 e.g. <i>Wienerberger, DE</i> 	10/8	0,40⁷⁾	0,60⁷⁾ 0,75⁸⁾
	12,5/10	0,50⁷⁾	0,75⁷⁾ 0,90⁸⁾
	15/12	0,60⁷⁾	0,90⁷⁾
	15,6/-	0,60⁷⁾	0,90⁷⁾ 1,20⁸⁾
Perforated clay brick VHLz; $\rho \geq 1,6$ as per EN 771-1, e.g. <i>Wienerberger, DE</i> 	12,5/10	10)	0,90⁷⁾
	15/12	10)	0,90⁷⁾ 1,20⁸⁾
	20/16	10)	1,50⁷⁾
	25/20	10)	1,50⁷⁾ 2,00⁸⁾
	35/28	10)	2,50⁷⁾
	45/36	10)	2,50⁷⁾
	60/48	10)	2,50⁷⁾
	60,7/-	10)	2,50⁷⁾
Perforated clay brick HLz; $\rho \geq 1,5$ as per EN 771 -1 e.g. <i>Wienerberger, BS, DE</i> 	10/8	0,60⁷⁾	0,50⁷⁾ 0,60⁸⁾
	12,5/10	0,75⁷⁾	0,60⁷⁾ 0,75⁸⁾
	15/12	0,75⁷⁾ 0,90⁸⁾	0,75⁷⁾ 0,90⁸⁾
	20/16	1,20⁷⁾	0,90⁷⁾ 1,20⁸⁾
	25/20	1,50⁷⁾	1,20⁷⁾ 1,50⁸⁾
	35/28	2,00⁷⁾	1,50⁷⁾ 2,00⁸⁾
	45/36	2,50⁷⁾	2,00⁷⁾ 2,50⁸⁾
	48,1/-	2,50⁷⁾	2,50⁷⁾
Partial factor $\gamma_{Mm}^{1)}$ [-]		2,5	

Footnotes see Annex C 11.

Frame fixing URD

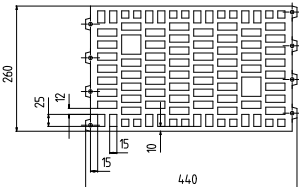
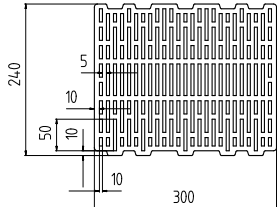
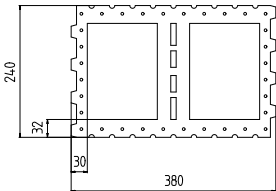
Performances

Characteristic resistance for use in hollow or perforated masonry

Annex C 19

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Table C20.1: Characteristic resistance $F_{Rk}^{12)}$ in [kN] for use in hollow or perforated brick masonry – base material group "c"

Base material; bulk density [kg/dm³] [Supplier Title, country] Geometry, DF or nominal Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771 / Minimum compressive strength single brick ⁹⁾ [N/mm²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		50	50
Perforated clay brick HLz; $\rho \geq 0,9$ as per EN 771-1 e.g. <i>Schlagmann, DE</i> 	5/4	0,40 0,50²⁾	0,60
	7,5/6	0,60 0,75²⁾	0,90
	10/8	0,90	1,20
	10,9/-	0,90 1,20²⁾	1,20 1,50²⁾
Perforated clay brick HLz; $\rho \geq 0,7$ as per EN 771-1 e.g. <i>Schlagmann Poroton T14, DE</i> 	5/4	¹⁰⁾	0,30
	6,4/-	¹⁰⁾	0,30 0,40²⁾
	7,5/6	¹⁰⁾	0,30 0,40²⁾
	7,7/-	¹⁰⁾	0,30 0,40²⁾
Perforated clay brick HLz; $\rho \geq 0,7$ as per EN 771-1 e.g. <i>Schlagmann</i> <i>Planfüllziegel, DE</i> 	2,5/2	0,40 0,50²⁾	0,60
	5/4	0,75 0,90²⁾	1,20
	7,5/6	1,20 1,50²⁾	2,00
	8,0/-	1,20 1,50²⁾	2,00
Partial factor $\gamma_{Mm}^{1)}$ [-]		2,5	

Footnotes see Annex C 11.

Frame fixing URD

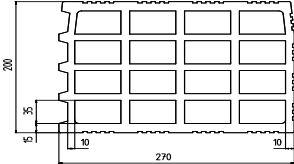
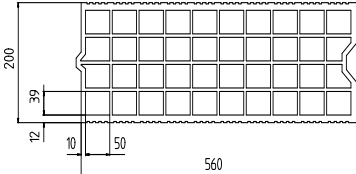
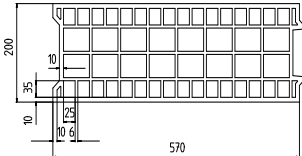
Performances

Characteristic resistance for use in hollow or perforated masonry

Annex C 20

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Table C21.1: Characteristic resistance $F_{Rk}^{12)}$ in [kN] for use in hollow or perforated brick masonry – base material group "c"

Base material; bulk density [kg/dm³] [Supplier Title, country] Geometry, DF or nominal Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771 / Minimum compressive strength single brick ⁹⁾ [N/mm²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		50	50
Perforated clay brick HLz; $\rho \geq 0,6$ as per EN 771-1, e.g. Imerys Gelimatic, FR  (500x200x270) Rotary drilling	5/4	10)	0,50 ⁷⁾
	6,5/-	10)	0,60 ⁷⁾ 0,75 ⁸⁾
Perforated clay brick HLz; $\rho \geq 0,6$ as per EN 771-1, e.g. Imerys Optibric, FR  (560x200x275) Rotary drilling	5/5	10)	0,50 ⁷⁾ 0,60 ⁸⁾
	7,5/6	10)	0,75 ⁷⁾ 0,90 ⁸⁾
	10/8	10)	0,90 ⁷⁾ 1,20 ⁸⁾
	10,5/-	10)	1,20 ⁷⁾
Perforated clay brick HLz; $\rho \geq 0,6$ as per EN 771-1, e.g. Bouyer Leroux BGV, FR  (570x200x315) Rotary drilling	5/4	10)	0,60 ⁷⁾ 0,75 ⁸⁾
	7,4/-	10)	0,90 ⁷⁾ 1,20 ⁸⁾
Partial factor $\gamma_{Mm}^{1)}$ [-]		2,5	

Footnotes see Annex C 11.

Frame fixing URD

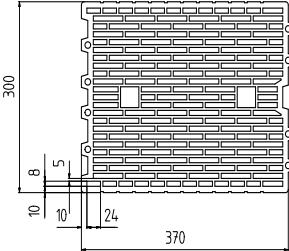
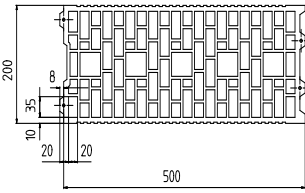
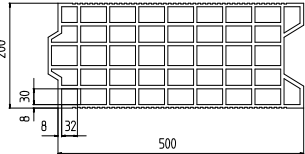
Performances

Characteristic resistance for use in hollow or perforated masonry

Annex C 21

Appendix 32 / 37

Table C22.1: Characteristic resistance $F_{Rk}^{12)}$ in [kN] for use in hollow or perforated brick masonry – base material group "c"

Base material; bulk density [kg/dm ³] [Supplier Title, country] Geometry, DF or nominal Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771 / Minimum compressive strength single brick ⁹⁾ [N/mm ²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		50	50
Perforated clay brick HLz; $\rho \geq 0,7$ as per EN 771-1, e.g. <i>Wienerberger</i> <i>Porotherm 30 R, FR</i>  (370x300x250) Rotary drilling	7,5/6	10)	0,40⁷⁾
	10/8	10)	0,50⁷⁾ 0,60⁸⁾
	10,7/-	10)	0,50⁷⁾ 0,60⁸⁾
Perforated clay brick HLz; $\rho \geq 0,7$ as per EN 771-1 e.g. <i>Wienerberger</i> <i>Porotherm GF R20, FR</i>  (500x200x275) Rotary drilling	5/4	10)	10)
	7,5/6	10)	0,40 0,50²⁾
	10/8	10)	0,60
	11,8/-	10)	0,60 0,75²⁾
Perforated clay brick HLz; $\rho \geq 0,7$ as per EN 771-1, e.g. <i>Terreal Calibric, FR</i>  (500x200x220) Rotary drilling	5/4	10)	0,30 0,40²⁾
	7,5/6	10)	0,50 0,60²⁾
	9,4/-	10)	0,60 0,75²⁾
Partial factor	$\gamma_{Mm}^{1)}$ [-]	2,5	

Footnotes see Annex C 11.

Frame fixing URD

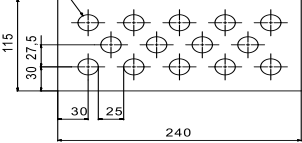
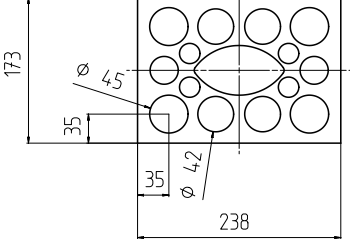
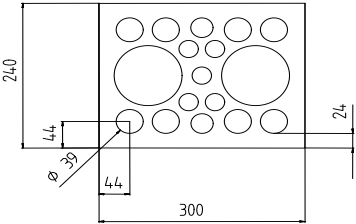
Performances

Characteristic resistance for use in hollow or perforated masonry

Annex C 22

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Table C23.1: Characteristic resistance $F_{Rk}^{12)}$ in [kN] for use in hollow or perforated brick masonry – base material group "c"

Base material; bulk density [kg/dm ³] [Supplier Title, country] Geometry, DF or nominal Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771 / Minimum compressive strength single brick ⁹⁾ [N/mm ²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		50	50
Hollow calcium silicate brick KSL; $\rho \geq 1,4$ as per EN 771-2 e.g. KS Wemding, DE 	7,5/6	0,75⁷⁾ 0,90⁸⁾	0,90⁷⁾
	10/8	0,90⁷⁾ 1,20⁸⁾	1,20⁷⁾ 1,50⁸⁾
	12,5/10	1,20⁷⁾ 1,50⁸⁾	1,50⁷⁾
	15/12	1,50⁷⁾ 2,00⁸⁾	2,00⁷⁾
	17,6/-	2,00⁷⁾	2,00⁷⁾ 2,50⁸⁾
Hollow calcium silicate brick KSL; $\rho \geq 1,4$ as per EN 771-2 e.g. KS Wemding, DE 	7,5/6	¹⁰⁾	0,60⁷⁾ 0,75⁸⁾
	10/8	0,50⁷⁾	0,90⁷⁾
	12,5/10	0,60⁷⁾	1,20⁷⁾
	15/12	0,75⁷⁾	1,20⁷⁾ 1,50⁸⁾
	20/16	0,90⁷⁾ 1,20⁸⁾	1,50⁷⁾ 2,00⁸⁾
	25/20	1,20⁷⁾	¹⁰⁾
Hollow calcium silicate brick KSL; $\rho \geq 1,4$ as per EN 771-2 e.g. KS Wemding, DE 	7,5/6	0,40⁷⁾ 0,50⁸⁾	1,20⁷⁾
	10/8	0,50⁷⁾ 0,60⁸⁾	1,50⁷⁾
	12,5/10	0,60⁷⁾ 0,75⁸⁾	2,00⁷⁾
	15/12	0,75⁷⁾ 0,90⁸⁾	2,00⁷⁾ 2,50⁸⁾
	20/16	0,90⁷⁾ 1,20⁸⁾	2,50⁷⁾
	25/20	1,20⁷⁾ 1,50⁸⁾	2,50⁷⁾
	35/28	2,00⁷⁾	2,50⁷⁾
5 DF (300x240x113) Hammer drilling	36,4/-	2,00⁷⁾	2,50⁷⁾
Partial factor $\gamma_{Mm}^{1)}$ [-]		2,5	

Footnotes see Annex C 11.

Frame fixing URD

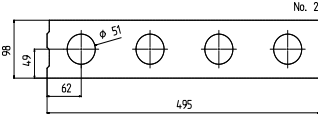
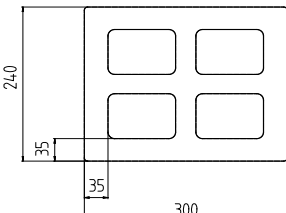
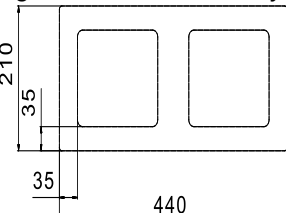
Performances

Characteristic resistance for use in hollow or perforated masonry

Annex C 23

Appendix 34 / 37

Table C24.1: Characteristic resistance $F_{Rk}^{12)}$ in [kN] for use in hollow or perforated brick masonry – base material group "c"

Base material; bulk density [kg/dm ³] [Supplier Title, country] Geometry, DF or nominal Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771 / Minimum compressive strength single brick ⁹⁾ [N/mm ²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		50	50
Hollow calcium silicate brick KSL; $\rho \geq 1,2$ as per EN 771-2 e.g. <i>KS Wemding, P10, DE</i>  (495x98x245) Hammer drilling	2,5/2	0,30 0,40²⁾	0,60 0,75²⁾
	5/4	0,60 0,75²⁾	1,20 1,50²⁾
	7,5/6	0,90 1,20²⁾	2,00 2,50²⁾
	9,4/-	1,20 1,50²⁾	2,00 2,50²⁾
Hollow brick light-weight concrete Hbl; $\rho \geq 1,4$ as per EN 771-3, e.g. <i>KLB, DE</i>  (300x240x240) Hammer drilling	2,5/2	¹⁰⁾	1,50⁷⁾ 2,00⁸⁾
	2,6/-	¹⁰⁾	2,00⁷⁾
Hollow brick light-weight concrete Hbl; $\rho \geq 1,2$ as per EN 771-3, e.g. <i>Roadstone masonry, IE</i>  (440x210x215) Hammer drilling	2,5/2	0,75⁷⁾ 0,90⁸⁾	0,90⁷⁾ 1,20⁸⁾
	5/4	1,50⁷⁾ 2,00⁸⁾	2,00⁷⁾
	7,5/6	2,50⁷⁾	2,50⁷⁾
	10/8	2,50⁷⁾	2,50⁷⁾
	11,3/-	2,50⁷⁾	2,50⁷⁾
Partial factor $\gamma_{Mm}^{1)}$ [-]		2,5	

Footnotes see Annex C 11.

Frame fixing URD

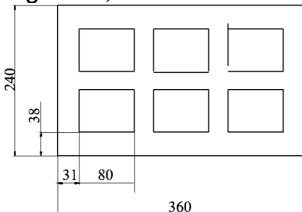
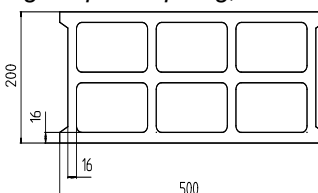
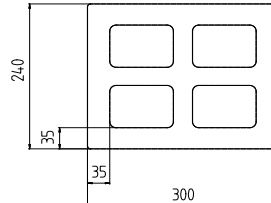
Performances

Characteristic resistance for use in hollow or perforated masonry

Annex C 24

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Table C25.1: Characteristic resistance $F_{Rk}^{12)}$ in [kN] for use in hollow or perforated brick masonry – base material group "c"

Base material; bulk density [kg/dm³] [Supplier Title, country] Geometry, DF or nominal Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771 / Minimum compressive strength single brick ⁹⁾ [N/mm²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		50	50
Hollow brick light-weight concrete Hbl; $\rho \geq 1,0$ as per EN 771-3, e.g. <i>KLB, DE</i>  (360x240x240) Hammer drilling	2,5/2	0,50⁷⁾ 0,60⁸⁾	10)
	5/4	1,20⁷⁾	10)
	6,3/-	1,20⁷⁾ 1,50⁸⁾	10)
Hollow brick light-weight concrete Hbl; $\rho \geq 0,9$ as per EN 771-3, e.g. <i>Sepa Parpaing, FR</i>  (500x200x200) Rotary drilling	2,5/2	10)	0,30 0,60⁷⁾
	5/4	0,30	0,60 1,20⁷⁾
	5,9/-	0,30 0,40²⁾	0,75 1,20⁷⁾ 1,50⁸⁾
	7,5/6	0,30 0,40²⁾	0,75 1,20⁷⁾ 1,50⁶⁾
	8,4/-	0,30 0,40²⁾	0,75 1,20⁷⁾ 1,50⁶⁾
Hollow brick normal concrete Hbn; $\rho \geq 1,6$ as per EN 771-3, e.g. <i>Adolf Blatt, DE</i>  (300x240x240) Hammer drilling	2,5/2	10)	1,50⁷⁾
	5/4	10)	2,50⁷⁾
	7,3/-	10)	2,50⁷⁾
Partial factor $\gamma_{Mm}^{1)}$ [-]			

Footnotes see Annex C 11.

Frame fixing URD

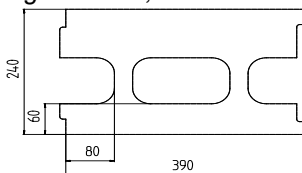
Performances

Characteristic resistance for use in hollow or perforated masonry

Annex C 25

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Table C26.1: Characteristic resistance $F_{Rk}^{12)}$ in [kN] for use in hollow or perforated brick masonry – base material group "c"

Base material; bulk density [kg/dm³] [Supplier Title, country] Geometry, DF or nominal Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771 / Minimum compressive strength single brick ⁹⁾ [N/mm²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		50	50
Heat insulation brick WDB; $\rho \geq 0,7$ <i>e.g. Gisoton, DE</i>  (390x240x240) Hammer drilling	2,5/2	10)	1,50 ⁷⁾
	3,7/-	10)	2,00 ⁷⁾ 2,50 ⁸⁾
Partial factor $\gamma_{Mm}^{1)}$ [-]		2,5	

Footnotes see Annex C 11.

Table C26.2: Characteristic resistance F_{Rk} in [kN] for use in unreinforced autoclaved aerated concrete – base material group "d"

Base material Size (L x W x H) [mm] and drilling method	Mean compressive strength as per EN 771-4 $f_{cm,decl}$ [N/mm²]	Characteristic resistance F_{Rk} [kN] Temperature range 30/50 °C and 50/80 °C	
		URD 8	URD 10
		h_{nom} [mm]	
		≥ 50	≥ 50
Autoclaved aerated concrete as per EN 771-4 <i>e.g. (500x120x300)</i> <i>e.g. (500x250x300)</i> Hammer drilling	$\geq 2,0$	5)	0,40 ³⁾ 0,50 ²⁾³⁾
	$\geq 3,0$	5)	0,40 ³⁾ 0,50 ²⁾³⁾
	$\geq 4,0$	5)	0,75 0,90 ²⁾
	$\geq 6,0$	5)	0,75 0,90 ⁴⁾
Partial factor $\gamma_{MAAC}^{1)}$ [-]		2,0	

1) In absence of other national regulations.

2) Only valid for temperature range 30/50° C.

3) The characteristic resistance F_{Rk} is also valid for installation in the stretcher and in the header side of the blocks.

4) Only valid for edge distance $c_{1,min} \geq 120$ mm $c_{2,min} \geq 180$ mm.

5) No performance assessed.

Frame fixing URD

Performances

Characteristic resistance for use in hollow or perforated masonry and unreinforced autoclaved aerated

Annex C 26

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